Moving beyond the single site implementations study

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Research Commentary

Moving Beyond the Single Site Implementation Study: How (and Why) We Should Study the Biography of Packaged Enterprise Solutions

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The single site implementation study is an invaluable tool for studying the large-scale enterprise solution. Together with constructivist frameworks and ethnographic approaches it has allowed the development of rich local pictures of the immediate and adaptive response by user organizations to the take-up of what are, today, often generic packaged systems. However, to view the packaged enterprise solution principally at the place where the user encounters it also has limitations. It produces somewhat partial understandings of these complex artifacts. In particular, it downplays important influences from other sites and time frames. This paper argues that if we are to understand the full implications of enterprise solutions for organizations then we should study their "biography." This idea points to how the career of workplace technology is often played out over multiple time frames and settings. To understand its shaping therefore requires scholars to go beyond the study of technology at a single locale or moment and, rather, attempt to follow it through space and time. The paper develops two ideas to aid this kind of study. We discuss better spatial metaphors that might help us explore the hybrid and extended spaces in which packaged software systems develop and evolve. We also review improved temporal understandings that may capture the multiple contemporary and historical time frames at play. The paper concludes by discussing some possible research directions that a focus on the biography of a technology might allow.

Key words: implementation; biography; ethnography; enterprise resource planning; sociology; actor network theory
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1. Introduction

The *single site implementation study* has become an invaluable tool for capturing the more fine-grained influences surrounding the implementation and use of large-scale workplace information technologies (IT). It has allowed information systems (IS) researchers to develop rich local pictures of the immediate and adaptive response by user organizations to the take-up of what are, today, often generic and packaged systems. A recent special issue of the *Journal of Strategic Information Systems*, for instance, extols the virtues of these more processual studies on the localization of enterprise-wide technology but also calls for research that examines packaged systems at different levels of analysis and over multiple periods of time (Howcroft et al. 2004). We welcome this call because it highlights important issues (not much discussed in relation to packaged software) of research design and methodology. This is because the lens by which much packaged workplace information technology is currently viewed—organization-level implementation studies (albeit often informed by microsociological analysis and ethnographic types of methods)—is inadvertently producing only "partial" understandings of these systems. There is a growing realization that the prioritization of the *local* and *immediate* circumstance surrounding enterprise solutions adoption and use is, by itself, no longer enough.

Lest we forget, packaged enterprise solutions are far removed from the relatively simple computer applications found in former generations of information systems. Koch (2005, p. 43) suggests that to

understand these complex artifacts, which he characterises as "heterogeneous assemblages of human and material elements" thoroughly penetrated by "soft elements," we must examine how they are inserted into organizational practices and *also* how they are evolving over time and across multiple sites of suppliers, users, and specialist intermediaries. He argues that enterprise resource planning (ERP) systems, for instance, need to be analyzed as "communities of software companies, customers, professional associations, different kinds of hardware and software, implementation procedures, practices, and rhetoric spanning time and space" (Koch 2005, pp. 43–44). This turns out to be difficult to do. One reason is that the IS field, as Orlikowski and Iacono (2001, p. 121) noted, has not fully engaged with its core subject matter—"the IT artifact." This appears particularly the case for packaged enterprise systems. These technologies are found to exhibit more complex dynamics than traditional software supplied on a bespoke basis (Light and Sawyer 2007). However, despite a growing appreciation of their differences, we have not yet developed a deep conception of the generic software package.

Recently, in this respect, there has been much enthusiasm in deploying more constructivist understandings of technology—especially interactionist work on computing (Star 1995, Star and Ruhleder 1996), ethnomethodology (Suchman 1987, 1994) and actor-network theory (ANT) (Latour 1987, 2005). Thus ANT, with its apparent willingness to shift between locales and levels of study, to be pursued through espousing simple methodological nostrums such as "follow the actor" (Callon and Law 1982, Latour 1987), seemed to be open to exploring the full array of actors and relationships implicated (Walsham 1997, Monteiro 2000). However, although effective in building "actor-centered" forms of analysis and foregrounding the range of players directly involved in implementation, this approach has been less successful in developing the more complex mappings and understandings that meet the above call that these solutions need to be studied over time and across space.

Dissatisfaction with the single site implementation study appears to be growing. Kallinikos (2004a) asserts that the most useful way to study ERP, for instance, is not solely at the place where users encounter it. There are numerous other (but much less researched) locales and actors that play a role in constituting these technologies and the markets in which they are located. Koch (2007) suggests we need better *spatial metaphors* for addressing what he describes as complex organizational technologies typically offered as standardized, packaged solutions and supplied internationally and across different sectors. This involves, he suggests, a move away from the single site research site to *multilocal* studies. Scott and Wagner (2003) similarly argue the need to develop better temporal understanding of ERP implementations that include not simply the immediate response by actors but also the *multiple* and often *longer-term* temporal conceptions that might surround deployment and appropriation (see also Sawyer and Southwick 2002).

Spurred on by these arguments, we concur with these writers on the need for better tools and heuristics able to exploit the respective strengths both of contemporary ethnographic studies and of longer-term and broader analysis (Kallinikos 2004a, b; Crowston and Myers 2004; Koch 2005, 2007). Thus we have begun to articulate the nascent biography of artifacts (BoA) approach (Pollock and Williams 2009a; see also Hyysalo 2010). This has its roots in research conducted over two decades ago on what were some of the first organization-wide packaged software solutions.[1] We noted then how the career of industrial applications often extended beyond that which could be studied at one site or moment of technology design or implementation (Brady et al. 1992). When manufacturing resource planning (MRP) solutions, for instance, were implemented they inevitably had to be tailored to fit the technical and operational circumstances of adopting organizations. The subsequent process of "innofusion" (Fleck 1988b) that occurred often threw up useful innovations that could then be fed back into future technology supply. Industrial automation artifacts were thus seen to evolve through successive cycles of technical development and industrial implementation and use—what Fleck et al. (1990) called a "spiral of innovation"—as the generic package was developed and applied in ever more settings. What we want to do now is develop this idea so that it might give a more comprehensive understanding of the evolution of a technology—encompassing both technology design and implementation/use—and how it is shaped by its specific historical context across multiple organizational locales. We also attempt to develop a set of conceptual tools for analyzing the social fabric beyond the supplier-user nexus. That is, to theorize in more detail the structuring and operation of the institutional setting surrounding packaged enterprise solutions.

[1] The biography of artefacts (BoA) approach is a set of heuristics that allows field-workers to probe technologies as they develop over multiple locations and different time frames (Pollock and Williams 2009a). The approach provides some of the analytical cues as to the important sites and settings for investigation, encompassing the broader context as well as immediate sites of interaction, but which is also open to the possibility of identifying important new phenomenon.

To do this, the paper will develop one specific proposition. It will suggest that rather than study technologies at particular locales or moments that we should *follow them through space and time*. This nostrum is not in itself novel. Other scholars have advanced similar proposals (Kopytoff 1988, Marcus 1995, Bruni 2005, Leonardi and Barley 2008), albeit about different kinds of artifacts. However, we argue, none have provided sufficient analytical cues to guide such an endeavour. This means it is often not clear how exactly one should pursue a technology (especially one whose shaping is as distributed in time and space as the packaged enterprise solution). Here we attempt to move the debate on by developing an improved spatial and temporal understanding of packaged enterprise solutions—which may be relevant for developing an understanding of the evolution of other large-scale complex technologies.

IS scholars have increasingly drawn on discussions from science and technology studies (STS) and related disciplines to help them understand the sociotechnical nature of the design and use of computers within organizations (we have already mentioned actor network theory but see also Orlikowski's (1992) discussion of the social construction of technology approach). We continue this productive exchange through examining the utility of the notion of "arena" (Jørgensen and Sørensen 1999) to explore the hybrid spaces in which different actor worlds interact and collide. We build on this to elaborate an understanding of the relationship between different arenas and levels and to show how local actions are set within broader settings. We also seek to provide a register of the multiple historical time frames at play (from the immediate moment of action to the long term in which institutions emerge and evolve), drawing on relevant ideas from distributed cognition (Hutchins 1995) and activity theory (Hyysalo 2004).

2. State-of-the-Art Enterprise Solution Literature

We begin by briefly reviewing the different kinds of study conducted into technology and work organization, exploring how these characteristic modes of empirical study impinge upon the framing of the research and its findings (Law 2004). We organize our discussion according to what we see as the four problems of contemporary scholarship into enterprise solutions. These are issues of time, of space, of actors, and of the broader institutional context.

2.1. Time: Short-Term Implementation Studies Emphasize Continuity

Implementation studies represent the bulk of research into new organizational technologies (for reviews of the extent of this literature see for example Esteves and Pastor 2001 and Al-Mashari 2003). The ERP Research Group (2006), for instance, notes that the overwhelming majority (over 95%) of the 600 ERP articles in its online bibliography correspond to what they describe broadly as ERP implementation studies—including also closely related topics such as the management of ERP adoption, organizational outcomes, and "critical success factors" (Al-Mashari 2003). Whereas much of the early work on ERP implementation was typified by fairly unreflexive "impact studies" (Grabot and Botta-Genoulaz 2005) that sought to chart the large-scale organizational transformations that these systems were expected to reliably deliver, more scholarly research with a stronger social scientific grounding began to appear a few years later. This latter research was often more rigorous and offered better and more critical insights. We note in particular the growth across a range of disciplines (including for example IS research, organization studies, management of change etc.) of more sociological research informed by a processual understanding of technical and organizational change and deploying often ethnographic research methods. This work yielded a richer knowledge base, going beyond the standard unitary managerial view of the organization and addressing different perspectives across and within organizational departments/functions and the particular processes that underlie these complex outcomes (see for example the articles in the special issue mentioned above Howcroft et al. 2004). Moreover, a great deal of this work has benefited from constructivist analysis of technology and the growing influence of interactionist studies of computing (Star 1995, Star and Ruhleder 1995), an ethnomethodological focus on software (Suchman 1987, 1994), and more recently the application of actor network theory (Monteiro 2000, Ciborra et al. 2000, Walsham 2001). As a model for research, these approaches focus valuable attention on the local negotiations and choices surrounding the implementation and use of new technologies. Particular consideration is given to immediate action and "heroic" local actors who, in the face of attempts to remodel or standardize their working practices, are seemingly able to rework the newly implemented information system in their favour (Orlikowski 1996, Ciborra 1999, Pozzebon and Pinsonneault 2005, Pozzebon and van Heck 2006, Elbanna 2006). One contribution of this type is Boudreau and Robey's (2005, pp. 14–15) actor centered perspective describing the various freedoms one particular group of organizational users were able to maneuver for themselves during an ERP implementation (and this was despite the fact the system was specifically designed to reshape their working practices).

> As they attempted to use [the ERP system, the users] perceived the system as inflexible and enacted several unintended patterns of use. Many users worked around system constraints and established tweaks to have the system work like they wanted. These reinventions allowed users to overcome their ignorance of the system and to compensate for its perceived limitations.

It must be emphasized that these studies have drawn valuable attention to the ways in which the outcomes of technological change often fall short of supplier promises. In particular, and among other things, they highlighted the gap between the formalized representations of organizational processes embedded in supplier offerings and the diverse circumstances of the user organization and their complex, heterogeneous and difficult to formalize practices (Brady et al. 1992, Ciborra and Hanseth 1998). Though recognizing the empirical richness of this work we wish to draw attention to the potential limitations that arises from the temporal framing of implementation studies. Even though these more sociologically informed studies may have a stronger grounding than earlier impact ones, they are still typically of short duration compared to the extended time frames involved in the complete adoption cycle (involving the initiation, procurement, implementation, use, maintenance, and subsequent review) for such kinds of radical technological and organizational change, with the result that researchers are prone *to leave too soon*. Implementation studies are still often based on short- or medium-term access, with fieldwork covering a few months or at most a year or two, and are therefore weak in terms of assessing longer-term outcomes of innovation episodes for organizational users.

We argue that implementation studies that end too soon may underestimate the eventual organizational consequences of an innovation. There is a danger, and this is a very real danger when extrapolating from individual implementation studies, of overlooking the gradual alignment and harmonization of organizational practices that may occur around the organizational templates embedded in the technology. Various writers pursuing a deeper understanding of the organizational consequences of technologies have sought a more intricate, dialectical understanding of the interplay between organizational structures and artifacts (Orlikowski 2006). Thus Kallinikos (2004b) sees ERP systems as embodying organization templates and taken-for-granted views of the firm and at the same time reinforcing the routinized view of organizational activities, thus conditioning the behavior of organization members. Benders et al. (2006) similarly suggest that standardized organizational technologies like ERP, with their general models of organizational centralization and standardized business processes, encourage diverse organizations to align over time with their embedded organizational models. They argue that this may constitute a new form—that they term "technical isomorphism"—of the isomorphic pressures asserted by neo-institutional theory as causing organizations to become increasingly similar.

We note that longer-term studies of technology and work organization, over extended time frames of decades, would draw attention to the concerted changes over time in how work is performed. This would stand in contrast to the picture emerging from the short-term studies of immediate action that provide ample evidence of the choices available to organizations in their adoption strategy and the diversity and contingency of technical and organizational outcomes.

Thus various studies of the immediate aftermath of implementation often show that existing organizational structures and practices (initially at least) appear more robust than templates embedded in ERP and other IT applications (Fleck et al. 1990, Clausen and Koch 1999, Boudreau and Robey 2005) and have paid particular attention to how it is users that play a key role in maintaining this kind of continuity. In our own ethnographic research on the implementation of ERP within a university, for instance, we advanced similar arguments suggesting that although the ERP system had been "successfully" implemented within the institution many of the existing work practices (which had been problematised as inefficient and needing to be transformed) carried on as before (Cornford and Pollock 2003, Pollock and Cornford 2004). Administrators had set up intricate workarounds that allowed old ways of working to coexist alongside those brought in with the new system. We presented what was an accurate snapshot at that point in time but also one that some years later, having had the good fortune to secure resources to revisit the fieldwork setting, did not provide an adequate account of longer-term outcomes. What we found was that the initial workarounds had all but disappeared and that practices and processes across the university had now mostly become aligned with those originally embedded within the ERP templates. What we took away from this was not that one or another approach was right or wrong, but that *stability* and *change* could occur around the same technology, albeit over an extended period of time, and that our initial research lens had not allowed us to see this.

Our reflections on these insights, in developing the BoA perspective, brought to our attention the often overlooked linkages between research methods, frameworks and empirical findings. If we are to understand the full (and long-term) implications of enterprise solutions for organizations, then we need analytical frameworks that can address sociotechnical relations over multiple time spans.

2.2. Space: Technology Vendors Made "Other"

Implementation studies also encounter the problem that many issues regarding the material character of artifacts are determined outside the setting of technology adoption (including the availability of technologies as well as the institutional context that provides resources and sets constraints for local action). Perhaps as a result, researchers frequently have the sense of not being in the right place at the right time (cf. Law 1994, Magolda 2000). One temptation faced with this incompleteness of vantage point is to bracket off all those spaces that cannot be studied and elevate the importance of the particular settings and interactions that can be accessed. This could be exemplified by workplace studies of technology that present organizational information and communication processes, including the appropriation of IT, as of paramount importance and correspondingly neglect technology design and other distal processes.

One implication of the current research framing is that scholars tend (perhaps unintentionally) to treat software and its suppliers as something of a "black box." Lacking access to sites of technology development, researchers conducting implementation studies have little opportunity to scrutinize the development processes and history that had given rise to it. Any inference about supplier behavior made in these studies is primarily derived from observations and perceptions within the user organization. This fragmentation and framing of enquiry has consequences. In particular, those analyzing design may succumb to the temptation of seeking to infer the implications of particular design choices for those using the artifact. In a study by Quattrone and Hopper (2006, p. 225) of the installation of an SAP system in an American user organization, for instance, the authors ask whether the system was designed around an "abstract ideal German organization." The suggestion (mostly implicit) is that this ideal is then later transferred to adopting organizations. They write: "We do not know whether SAP is designed with an idealized German organization in mind or whether the manager had been to Germany but he could talk about 'a German company' without exactly knowing what he is referring to."

This kind of approach to analyzing technology design offers rather simplistic presumptions about the development history of particular applications and how initial design will affect users. The failure to open this black box means some of the most important actors and factors in the history of ERP have not yet been sufficiently investigated. What is the provenance of this leading enterprise system? What were the vendor's intentions during design? Did it envisage an "ideal" model of organization? If yes, how is such an ideal developed and represented within the design process? Understanding these issues, as well as the everyday reality of design and development work and the internal exigencies that exist within supplier organizations is of obvious importance. However, those conducting implementation studies have been largely reticent about the world of technology design. Paradoxically, perhaps, because of this lack of attention, the software package vendor has been made "other" and, where discussed, one-sided accounts, and on occasion negative stereotypes, have been deployed to characterize their behavior (Hanseth and Braa 2000, Walsham 2001). Drawing perhaps on critical perceptions of supplier offerings and behavior within the user organization, these accounts often convey a negative sense of the role and contribution of external technology providers (a perspective hard to reconcile with the fact that it is the user organization that decides to purchase from the vendor).

This brings us on to consider how to address technology supply. Rather few studies have been undertaken of the contexts in which organizational technologies have been developed and evolved. This fragmentation and framing of enquiry has consequences. It has meant there has been little focus on the relationship between supplier and user organizations with the result that little is known about how package suppliers interact with their users. Some scholars have gone as far as to suggest that interactions with users are not central in the design of generic packages (Regnell et al. 2001, Sawyer 2001). Thus Regnell et al. (2001) emphasize the *autonomy* of suppliers and the space they have to "invent" requirements before they offer them to chosen markets. We have reservations about the idea that requirements are *invented* insofar as it conveys a sense of the autonomous developer; requirements engineering here is portrayed as something like market research about essentially unknown users. This contrasts sharply with the situation we found during our own field-work in which development and design choices were conditioned by linkages with established and potential organizational users.

There is an extraordinarily intricate web of formal and informal linkages between package vendors and organizational users (Keil and Carmel 1995). We (Pollock et al. 2003, 2007) conducted one of the few ethnographic studies of the development of a major ERP module. This was the development of "Campus" (a module used to manage students in higher education) where we were able to observe these linkages in a number of different ways. Here, because of space restrictions, we note only three:

(i) Rather than keeping users at a distance it was observed how the vendor worked with certain key user organizations to help guide the evolution of the new software module. Instead of building

this around an "ideal" organization (Quattrone and Hopper 2006) the vendor utilized a number of geographically dispersed "pilot sites," each of which were chosen to represent major international markets as well as the different "classes" of organization that might potentially acquire such a system. Many of these sites participated with the assumption that they could influence the design of a generic package—and indeed many appeared to find success in wielding influence (Pollock et al. 2003). However, it was noted that whereas in the early development of a packaged solution the vendor could be rather flexible in taking on board requirements of new customers, quite rapidly a more selective and managed approach to user requirements emerged. Package vendors, it seems, have developed sophisticated practices—what we have elsewhere termed "generification" strategies (Pollock et al. 2007)—to create and further develop standard offerings by actively managing relationships with customers. They typically do this through extending the design process (notably of requirements capture and analysis) to community forums and by actively differentiating between users, so that the supplier response is segmented according to the strategic and commercial importance of particular pilot sites. Thus, user requests for new functionality would usually include an assessment of the other potential users and markets that might require it.

(ii) In a later study of the same module, we also saw how a user organization and its vendor developed new functionality so that Campus could be integrated with previously unconnected ERP modules and bespoke systems, giving the organization one of the first fully integrated student recruitment and registration systems in the world. When implemented, and despite the fact the work had been completed jointly by programmers at the user organization and the vendor, the software was appropriated by the vendor to be sold as part of its global solution.[2]

(iii) We also observed the evolution of the module through long-term participation in a particular vendor user group. Here we observed the user community that had become attached to the module and wider ERP system. Indeed the user group represents one of the most important coupling mechanisms between users and vendors. There are still however very few fine-grained studies of how these groups function and descriptions of their linkages back to software vendors (but see Locke and Lowe 2007). One of the potentially surprising findings from research on these groups was our observations of the efforts of certain user organization members to ensure the development and extension of "their" ERP system. There was a serious commitment by certain users to help the vendor's systems achieve success. This involved not simply attendance at user-group meetings, but their active involvement in feeding back ideas to the vendor and even in promoting and helping to "sell" its products to other potential users in the sector. They undertook this effort because they perceived the success of the module and wider extension of the system was also in their interests (see below).

In short, we were able to build up a comprehensive picture of the web of relations surrounding the evolution of this particular module. What we saw was that design—and the coupling between artifact design and its implementation and use—is worked out through a range of different networks and intermediaries linking suppliers and users. It is also being worked out over multiple settings of organizational implementation (implementation cycles) and, in aggregated form, over multiple product cycles. This observation suggests that we need to attend to technology design and implementation in tandem (Fleck 1988a, b, 1993; Fleck et al. 1990; Lewis and Seibold 1993, 1998; Leonardi 2009; Hyysalo 2010). Yet there are almost no studies addressing software package design and implementation together. Why is this? We can identify some practical reasons, which include the difficulties in obtaining access to commercially sensitive sites of technology development, and the fact that there are far fewer developer firms than users. No less important may be disciplinary divisions: organization and management studies, for instance, from where many of the ERP implementation studies have been carried out, are concerned with organizational process and outcomes and have therefore tended to focus on the organizational user and consequently black box the supplier and their technology (Leonardi 2009). Also important is the very practical issue that package development is in most instances not only organizationally but temporally separated from implementation. The lag between design of a technology and its implementation typically exceeds the duration of most social science research projects. Researchers contemplating the trade-off between depth of fieldwork and the number and range of fieldwork sites of technological innovation have tended to opt for one or the other setting. This trade-off is made more difficult by the current emphasis upon contemporary studies and especially ethnographic approaches.

2.3. Actors: Enterprise Solutions Are Surrounded by a Large Number of External Experts and Intermediaries

We are arguing that when scholars focus on any one particular locale or moment in the biography of the enterprise system that they "background" or

[2] This observation offers an exemplary illustration of innofusion and the "spiral of innovation" (Fleck et al. 1990).

ignore important influences from other levels and timescales. This is particularly the case for the new kinds of external actors and intermediaries that have emerged in recent years. Their role and influence has not been captured in the bulk of ERP implementation studies. This issue was brought home to us when we conducted a study of a user organization's attempts to procure a customer relationship management (CRM) solution (Pollock and Williams 2007). Whilst conducting fieldwork, the primary empirical focus was initially upon the immediate level of organizational actors involved in the procurement decision. However, there were also a number of expert intermediaries and consultants enlisted to assist with the acquisition (including industry analysts, whose growing role is discussed below) as well as the supplier and its competitors and collaborators. All of these together constituted the immediate network of directly engaged players. Thus, we tracked an array of relationships out from the organization contemplating enterprise system adoption. This suggested that research on information system acquisition requires that the analytical lens move beyond the immediate interorganizational level of direct interaction between suppliers and users to focus also on the broader terrain of suppliers of classes of products, their customers, and the diverse webs of relationships and intermediaries linking these together.

The procurement of enterprise-wide packages represents something of a difficulty for user organizations. These large organizational software systems although expensive and of great strategic importance to the organization, are extremely complex and hard to assess in advance of their implementation. Their adoption can represent a reworking, if not complete replacement, of the organization's information infrastructure. These substantial and often business-critical decisions about what may be major strategic investments are carried out infrequently by user organizations, which in consequence often lack the expertise and experience needed for effective decision making. These features frustrate the conventional mechanisms by which purchasers might seek to scrutinise the properties of a material product.

In this context, a number of other mechanisms have acquired particular significance. First, Finkelstein et al. (1996) have drawn attention to the influence of advertisements and supplier literature. They also point to the importance of observed use of the packages in other settings (such as "demonstration sites" where the package has been installed; Smith 2009) and comparative studies provided by third parties (trade papers etc.) (on this latter issue see Wang and Swanson 2008). As well as drawing information from published knowledge and technology suppliers, potential adopters seek more impartial information through informal links with similar organizations (Tingling and Parent 2002). Second, many adopters also find it beneficial or feel compelled to deploy third party players such as expert consultants or system implementers. These groups on the face of it appear better placed to acquire and deploy the relevant knowledge about, for example, available products and the implementation process. As a result, such third party players often mediate between adopter and supplier(s). The micropolitics of the decision-making process thereby take place on a complex interorganizational, as well as intraorganizational stage. The resort to external expertise to reduce uncertainty felt by the organizational adopter about how to develop and implement its own strategy creates, in turn, new kinds of uncertainty (for example, about how to select the right consultant see Hislop 2002).

Thirdly, out beyond these contexts, our attention was drawn to the combined actions of the diverse players that constituted "the market" of technology artifacts, the field of technological practice, and also intermediaries that channel information through these collective spaces. Comparing the procurement of CRM at the turn of the century with that of ERP a few years earlier (Tingling and Parent 2004), and computer aided production management (CAPM) systems back in the 1990s (Webster and Williams 1993), we are struck by the increasingly sophisticated sources of specialized information that are now available about this and other workplace technologies. This arena is comprised of suppliers, users, consultants, and interorganizational networks, which include sectoral networks, professional associations, and latterly user groups organized by vendors as well as industry analysts. It is the latter that constitutes a novel and increasingly influential category of player.

Our concern to analyze procurement stimulates us to address the ways in which beliefs about the provenance of a technology are constructed across a community of supplier and user organizations. In our research, we have examined the emergence of new kinds of intermediaries who are also market makers and conveyors of community information. We have found that industry analyst groups (like Gartner, Forrester, Ovum etc.) are important because they act as repositories and organizers of what might be thought of as "community knowledge" about the implementation of particular products and about the reputations of suppliers. This involves, crucially, the experiential knowledge solicited from technology users that is deployed in the construction of evaluative tools like Gartner's "Magic Quadrant" or the "Forrester Wave" (Pollock and Williams 2009b).

2.4. Broader Institutional Context: Technological Fields

Our work seeks to explore how local struggles are taking place within broader circuits of knowledge and influence, including economic and social structures and material structures (and we suggest that a study of technology needs to engage with technology as a materialized institutional form) that mobilize beliefs and visions and provide various incentives, resources, and penalties and which thus set the parameters in which local actions are played out. This is, first, in terms of the relationship between changing conceptions of an organizational technology and the circulation of broader views of industrial improvement (which inform prescriptions of "best practice"); it is, second, with visions of how these may be fulfilled by emerging technologies. Swanson and Ramiller (1997) have highlighted the role of "organizing visions" in information systems innovation, encompassing interpretation, legitimation and mobilization, which help mobilize the material and intellectual resources needed for innovation (Swanson 2010). To give one important example, it was the industry analyst Gartner that initially coined the terminology of the technological field that became known as "enterprise resource planning" back in the 1990s. Gartner's scenario document, *ERP: A Vision of the Next-Generation MRP II* (Wylie 1990), proclaimed this technology as the "new information system paradigm." Not only did Gartner coin the term but it went further, attempting to set out what functionality it should contain. Soon after, other players (most notably vendors and consultants) began to flesh out what ERP was and how it worked, followed by adopter accounts of the organizational benefits of its adoption (Wang and Ramiller 2004). Perhaps building upon this initial involvement, Gartner appeared to continue to exercise a hold over the activities of ERP vendors. This was in particular through the production of the "vendor briefings" that worked to constitute particular vendor offerings—a technology like SAP's R/3 system, for example—as an instance of ERP (Pollock and Williams 2009a). More recently, Gartner has attempted to chart the technology's future development trajectory (Mabert et al. 2001, Judd 2006). Gartner boldly, and somewhat prematurely, declared ERP "dead" and mapped out a transition to the next phase described as "extended ERP" or "ERP II" (Bond et al. 2000).

To summarize this discussion of the enterprise system literature, we are concerned to develop alternative models for the analysis of technological innovation and associated organizational change—as these frame the analysis and guide the methodology adopted and thereby what it is we can and cannot find out. The analytical frameworks we adopt in an enquiry are important, embodying, as they do, assumptions about the world and about how we may investigate it. They thus pattern the tools and methods of enquiry and shape the kinds of understanding we are likely to reach (Law 2004). Our aim is to build a comprehensive understanding of the evolution of a technology—encompassing both technology design and implementation/use—and how it is shaped by its specific historical and institutional context across multiple organizational locales. However, in our review of contemporary IS literature, we have identified some of the ways in which the characteristic modes of empirical study impinge upon our ability to produce the biography of the enterprise solution.

2.4.1. Temporal Framing. Implementation studies tend to be relatively short term compared to the extended time frames involved in the complete adoption cycle (involving the initiation, procurement, implementation, use, and subsequent review of systems) with the result that researchers often "leave too soon" and may underestimate the eventual organizational consequences of an innovation (Kallinikos 2004b, Berchet and Habchi 2005, Boudreau and Robey 2005, Benders et al. 2006).

2.4.2. Spatial Framing. Studies are often constrained to specific sites with other related settings often being "black boxed." However, there is an increasing awareness of the need for multisite analysis that addresses the settings of technology development, implementation, and use *together* so that studies are able to capture the many formal and informal linkages between vendors and users (Fleck 1988a, b, 1993; Fleck et al. 1990; Lewis and Seibold 1993, 1998; Leonardi 2009).

2.4.3. Actors and Intermediaries. One implication of the current temporal and spatial framing is that certain kinds of players are foregrounded whereas others are backgrounded or ignored. However, the enterprise solution arena is populated by a vast range of actors and new kinds of intermediaries that support the market-based supply of standardized organizational software products to handle the complex transactions and knowledge flows between vendors and users (Finkelstein et al. 1996, Wang and Swanson 2008, Smith 2009). Some of the most important interactions are at the interstices between organizational domains. Here we flag the role of formal and informal intermediaries in supporting knowledge flows and alignments across boundaries.

2.4.4. Technological Field. A further implication is that studies are often blind to the ways in which the take-up of packaged solutions and their subsequent evolution are shaped by developments within the wider terrain (Swanson and Ramiller 1997,

Swanson 2010). In particular, how certain actors seek to establish boundaries around a technological field and draw up signposts about the state of the industry/technology and its future development (Pollock and Williams 2010).

Before moving onto discuss some of the spatial and temporal concepts we might use to explore enterprise systems we think it necessary to highlight how our thinking differs from the more mainstream constructivist approaches to the analysis of technology and work. In particular, we highlight the limitations of actor network theory as it has been applied to packaged software.

3. Constructivist Approaches to Technology: Actor Network Theory

We particularly focus on ANT here because it is one of the frameworks that has most deeply shaped current understandings of enterprise systems and workplace information technologies in recent years (Walsham 1997, Hanseth and Braa 2000, Ciborra et al. 2000, Scott and Wagner 2003, Pollock 2005, Rose et al. 2005, Shoib et al. 2006, Beekhuyzen and von Hellens 2006). This is evidenced by the observation that Bruno Latour, Michel Callon, and John Law, the principle proponents of ANT, are among the most cited social theorists in a recent survey of IS literature (Jones 2000, Ho and Tan 2004). ANT is an approach that has also influenced our own thinking on information systems in two ways. This is both in the sense that it has developed insights that we are happy to take on board but also in that we see our emerging BoA perspective as an attempt to redress some of the shortcomings that beset ANT type analysis when applied to packaged software. This is what we turn to now.

Early contributors to ANT primarily addressed innovations and innovators that established new fields of technoscientific practice.[3] As these were often out with existing institutional structures, ANT theorists were able to "foreground" the actors directly involved and discount contextual influences. Analysis often focused particularly on "heroic" technical specialists, who were conceived as "Sartrean engineers" (Latour 1987), apparently outside or able to operate free from constraint from social structure. ANT insists on explaining outcomes solely in terms of the success of innovation actors in enrolling others to support their project through various *enrollment* strategies (Callon and Law 1982). These strategies included *problematisation*, the definition of difficulties/limitations in a way that the primary actors establish themselves as the source of solutions; and *interessement*, where they convince others that their interests are best met by aligning with their project.

Here, ANT has offered a critique of existing social science theory that tended to explain social outcomes in terms of the operation of power or interests rooted in existing social structures (Callon and Law 1982). In contrast, for ANT, "power," and technological change are contingent outcomes—a consequence (rather than a cause) of the success of actors in enrolling and mobilizing others (Callon 1986). In place of examining the world on the grounds of a priori theoretical categories and concepts, ANT espouses a simple methodological rule: researchers should follow the actors wherever they go (Callon and Law 1982, Latour 1987). This has supported a willingness to move between locales and levels of study. However, we would argue that this nostrum has proved inadequate. For a start, every research design involves choices about where to address research effort, and tacitly therefore choices about which black boxes to open for detailed examination/and which to leave unexplored. The obvious question is "Which actors to follow?" As Sørensen and Levold (1992) noted, a plurality of accounts could be possible depending upon which actor(s) were placed at center-stage, leaving the researcher lost in a morass of possible stories.[4] It has been further suggested that actor-centered accounts yield unbalanced explanations (Kallinikos 2004a): ANT scholars tended to follow technical specialists giving rise to an unintended privileging of technical actors over, for example, politicians or bankers (Sorensen and Levold 1992), and they relegated to the background, or ignored entirely, the historical and institutional factors that underpinned these developments. These shortcomings are particularly problematic when deployed to analyze the development of workplace technologies and other instances of incremental innovation within well-established institutional settings. We find that local actions (e.g., ERP implementations) are

[3] We emphasize the word "early" here as our work primarily addresses some of the first ANT studies that were to emerge. There has been a long-term discussion within science and technology studies about the operationalization of ANT type analysis (Sørensen and Williams 2002). In this respect, ANT has been the subject of much critique over the years from those within STS, but, importantly, it is a critique to which it has forcefully responded (see for instance Latour 2005). Through these exchanges, it has evolved as an approach (and there have been substantial accommodations on both sides). Thus Law and Singleton 2005 can talk about three different "versions" of ANT having emerged over time. Our critique here is targeted at the initial version for it is primarily these and not later ones that have been imported into IS research. Thanks to the associate editor of this journal for helping us to clarify this point.

[4] ANT's scepticism toward existing social science theory, on the grounds that it necessarily imported unwarranted assumptions and generalizations, paradoxically leaves the research processes, and the choices inherent in research design, underspecified and unaccountable.

sustained and constrained by an extensive network of technical, organizational, and social arrangements whereby some (material, institutional) elements are difficult for local actors to change (cf. Kallinikos 2004a, b; Koch 2005).

ANT helpfully problematised rigid theorizations concerning the prioritization of particular locales and settings (i.e., "localization arguments"; Knorr-Cetina 1981, Callon and Latour 1981). Yet once having done this it provides rather few clues as to how these different scales should be addressed. Similarly, proponents of interactionist and microsociological forms of analysis have argued that their approaches can be *scaled up* to deal with more globalized or enduring types of phenomena (Knorr-Cetina and Bruegger 2002, Suchman 2007). However we remain skeptical regarding the practical forms of guidance they give to researchers about how to address technologies across multiple levels and time frames. In the absence of specific guidance, there is the risk that researchers focus predominately on immediate relations. This characteristic is undoubtedly reinforced by the emphasis within these approaches on ethnographic methods. Though strong in capturing the richness of local processes in real time, ethnographic methods are labor intensive. Ethnographers have often therefore opted for relatively simple research designs—mostly involving single site studies or studies of a number of closely related settings (Marcus 1995); these studies, then, are what we have described elsewhere as "flat ethnographies" (Pollock and Williams 2009a).[5] These may be adequate for understanding simple social formations (as perhaps exemplified by social anthropological studies of "the family" or "the tribe") but have serious drawbacks in grappling with the multiple interconnections of modern societies arising in particular from globally integrated technological systems.

This suggests we need a more "contexted view" (Morrison 2002) able to address the complex social fabric and its history that patterns the activities of those involved locally. Moreover, our explanatory frame needs to be one that avoids the simplifying logics of particular disciplinary approaches or schools, and that can match the intricacy of the settings and processes we are studying. We start with the observation that the character of packaged solutions is being shaped at a number of levels ranging from local contestation around features of artifact design or organizational implementation to the broad macro-level that we characterize as the technological field. The complex web of relationships involved moreover changes over time—it is as Koch (2007) observes a "moving target." This alerts us to the need to address how individual actors (e.g., suppliers, potential users, intermediaries) and the relationships between them are conditioned by their broader setting. How then shall we conceptualize the broader setting?

[5] We define "flat ethnographies" as studies of confined sites and time frames of action, arising because of unreflexive selection of settings and framings (e.g., the implementation study), or the adoption of simple methodological nostrums—such as "following the actor" (Callon and Law 1982, Latour 1987).

4. Concepts for Exploring Multiple Locations

4.1. Arenas of Technology Development and Implementation

How then can we conceptualize the complex space that links together material artifacts, practices, and visions within an extended fabric of individuals, organizations, interorganizational structures, and user communities? As Koch (2007) argues, we need better spatial metaphors for addressing this rich tapestry, characterized by heterogeneous linkages and also by gaps in time and space. We could theorize this as a "distributed innovation process," a concept advanced by innovation economists (von Hippel 1994), or as the operation of an "actor network" in the way ANT might do (Callon 1986). These however represent a very imprecise way to characterize what is in fact a rather structured set of relationships. The metaphor of network has been popular partly because it can readily be applied to many different contexts. However, as Knorr-Cetina and Bruegger (2002, p. 910) note, networks are "sparse social structures" and although the notion could be used to map the heterogeneity of actors involved in a typical ERP implementation it is difficult to see how it might do justice to the intricate and heterogeneous pattern of linkages that exist between players.

We have been attracted by Jørgensen and Sørensen's (1999) concept of "development arena." The value of the concept for us is that, seeking to provide tools for ANT-based explanation to deal with the broader interactions evident in global technology developments, it conceives of the arena as a space (using the analogy of a circus ring drawn in the sand) in which a number of more or less conflicting local actor worlds collide. Their analysis emerges from a concern that fieldworkers following network builders tend to overlook those actors that become, for whatever reason, "excluded by the dominant translations" (ibid. p. 418). In particular they note how "... in competitive business, research, or national environment, other actors soon start to try to enter the arena, possibly by introducing new actor worlds and thereby reshaping the reference points for all other involved actors" (ibid. p. 418). In addition, through noting previously excluded actors, they flag the possibility of radical reconfigurations of an arena through changing boundaries and realignment of players, providing

tools to explain destabilization as well as alignment. Jørgensen and Sørensen (pp. 417–418) write:

> . . . a development arena is a visualizing spatial expression of processes of competition and cooperation. It should convey the idea that several actor worlds are being construed within the same problem area. It depicts the idea that several actor networks coexist and interfere with each other within a certain problem space. A development arena is our attempt to bring together processes or entities that would otherwise seem to be dislocated. It can be seen as the place where actors relating to a certain set of problems meet and exchange ideas etc. It is a place relatively independent of geographical location but containing many locales through translation. Each hybrid actor in the arena has multiple geographical belongings.

However, characterizing the development and evolution of complex organizational technologies, such as packaged enterprise solutions, as a single arena may underplay the very different textures of the fabric of social relations involved (what we may describe, extending the metaphor, as a complex patchwork or tapestry). It would be possible to expand Jørgensen and Sørensen's (1999) development arena to *include* implementation, but this would be to overlook the asymmetries and tensions between development and implementation. It may be instructive to examine moments of design and development of artifacts separately from their implementation and domestication, as we see these moving not always in synchronization but often exhibiting different dynamics.[6] However, we also need to be able to examine these in tandem.

We propose therefore to describe the setting for development and evolution of packaged enterprise solutions in terms of a multiplicity of overlapping arenas: these could be development arenas, implementation arenas, interorganizational arenas of user firms, and networks of external experts, and so on.

(i) Fleck's (1988a) "innofusion" framework had similarly flagged the *arena of implementation* as a key site of innovation in industrial technologies. He has a rather similar concept of the arena to Jørgensen and Sørensen as an interorganizational space comprising members of supplier and user organizations and constituting a setting for practical learning and struggling, in which different kinds of competence and knowledge are deployed (e.g., the engineers' knowledge of computer science techniques and artifacts and the organization members' knowledge of their context and purposes). Our initial concept of the biography of a technology was based on the idea of an artifact alternating between moments of innovation in technology supply and implementation (see Williams 1997).

Fleck's (1988a) initial framework pointed the way to the need to address broader spaces, but his formulation seems to us less adequate today as our attention has turned to look in more detail at the myriad forms of direct and indirect relationships linking supply and use and shaping of the overall character of offerings in a technological field.

(ii) We would particularly highlight the increased role and importance of a new empirical phenomenon (and feature of late capitalism) in the last decade or two in which suppliers have developed mechanisms to sustain a more or less *permanent* relationship with their existing and potential customers (Sørensen 1996). The rise of the "software package user group" exemplifies this most visibly where users formally gather and organize to interact with and exert influence over technology vendors (Akera 2001, von Hippel 2005). These are key settings for study in their own right as they exhibit interesting dynamics. Among other things, they are sites of both *cooperation* and *competition*. Here community members are drawn to collaborate with other user firms to petition the vendor to continue to support the product and develop its general functionality. They have an incentive to raise collective expectations about innovation, to establish a body of support, and to promote certain paths among other possible ways forward as the road for improvement. Simultaneously, they need find some way to promote particular claims about their own individual needs, to convey to the vendor that meeting *their* requirements offers an advantage over meeting those of other users. Thus, we find organizational users on the one hand competing with other user community members to build their own particular cases, but on the other hand also operating in tandem with them to establish generic support for particular innovation pathways.

An analysis of the shaping of ERP, even at the level of the single software lifecycle, needs to address the broader web of relations that constitute the broader context, which Koch (2003, 2005) has characterized as the ERP community. However, to carry this idea forward, we seek to enquire how this community is established and contexted. This is, first, to draw attention to the internal constitution of this community (i.e., how it is made up from various other specific

[6] Sørensen (1996) draws upon the Silverstone et al. (1992) concept of "domestication" to describe the work done by users of technology to incorporate artifacts into their practices. In relation to industrial IT applications, the domestication and appropriation concepts have been used to explore how IT artifacts (software, hardware, classification systems) become part of functioning information systems within the organization, through the efforts of organization members to incorporate them into their information and coordination practices. That is, supplier offerings are inevitably generic and unfinished in relation to specificities of practice of particular organizations and groups, and thus require a creative effort by users by developing new routines and practices to get the system to be useful and, through what are known as workarounds, make up for its deficiencies.

arenas and how it develops through distinct sets of relationships) and, second, to examine the external constitution of this community though the operation of what Kaniadakis (2006) described as the broader agora of technology and work organization.

(iii) The "agora" is conceived as a meeting place and a marketplace for ideas. Here ideas are circulated both about good industrial practice as well as about how this can be achieved through new technologies. This is where technological fields come to be constituted, and certain concepts achieve wide currency, in a process catalyzed through the activities of certain key players—in the case of ERP, notably vendors, consultants, and industry analysts—and also ultimately sustained by the activities of wider communities of organizational users and others. These concepts and broader visions provide crucial resources within which vendors, and technology and change management consultants can articulate their offerings. In our work, we drew attention to how industry analysts seek to establish boundaries around the field and generate assessments of the relative location of various suppliers (their current products and future prospects) within the product market for different user sectors. In addition, we noted the role of Gartner and other analysts in drawing up signposts about the state of the industry and its future development (Pollock and Williams 2010). However, it is important to note that the development of technological fields is not a space "owned" by any particular group of practitioners, vendors, users, or analysts. Rather, there are many other actor worlds and arenas interacting and competing within this space. Its composition is changing. For example, when Gartner coined the notion of ERP it was one of only a few actors able to designate a technology. Today, however, in its subsequent attempts to shape CRM, for instance, it has found itself competing with many other industry experts and consultants. There are now many more players articulating visions of the enterprise technology fields (Swanson 2010).

In setting out these specific arenas, however, we do not wish to distract attention from the fact that many players appear in multiple arenas (for example of technology development or procurement or implementation). Characterizing these as entirely separate spaces may not be helpful to our current concern to develop multilocal theorization of both the many kinds of supplier-user relationships and of the overall development of a technological field. Instead, we want to look at the various different kinds of relationships established between broadly similar or at least strongly overlapping groups. Furthermore, we would argue that the main difference between the arena notion and original ANT approaches is that the former gives us the analytical cues for analyzing the various kinds of social relationship that exist beyond the immediate interorganizational level of direct interaction between supplier and user. This approach is suggesting that, firstly, other actors are present and active in the arena and, secondly, that the space is shaped by numerous other arenas. Moreover, going beyond the current fashion in qualitative social science to deploy deliberately naïve methodologies, we can utilize our theoretical and substantive knowledge—in particular our idea of the biography of packaged software—to show how there are multiple possible different actor worlds and arenas surrounding enterprise solutions.

We propose a method of looking more systematically at the range of interlocking contexts in which sociotechnical phenomena emerge and evolve. This gives us the possibility of capturing actors and interactions previously backstaged and also provides a preliminary basis for making greater sense of their activities and roles. For instance, as mentioned above, in our work on the design of an ERP module, we initially noted how certain software package users would invest a significant effort in attempting to "sell" the vendor system to other organizations. This included acting as a "reference site," hosting potential adopters, but also giving talks about the benefits of the solution at industry forums. Such behaviour might appear, prima facie, to be bizarre or "idiosyncratic" to this particular setting (the reading one finds in Rowlands 2010 for instance). Why would these users—who were "the customers" of the vendor after all—act in such a way? Why is such behavior relatively widespread? However, if we consider that there are long-term relationships between vendors and users and that they adopt strategies and forms of positioning in relation to each other then this activity is perhaps easier to understand. Although software package suppliers characteristically attempt to keep users at a distance, they may benefit from closer relationships with pilot sites and key customers. Equally, user organizations may identify benefits from getting closer to the vendor (to enjoy higher levels of influence in the shaping of subsequent developments Pollock et al. 2007). This included helping sell the vendor systems to others in their sector—which would, for example, help ensure the continued investment by that supplier in that market segment.

We introduce into our analysis existing ideas about the significance of these relationships not as the finalization of enquiry but as the starting point for investigation. Without such an analytical schema and the research design that it informed, these kinds of interactions might readily have gone unnoticed (or appear as highly unique to a setting). The benefits of this kind of theorization are that it opens up opportunities to address the intricate structure of this community and develop methodologies to capture this.

These arenas could delineate a generic and broad theorization of the marketplace for IT or could involve a narrower focus around the viewpoint or perspective of particular actors or the analyst's concerns with particular processes and issues. Depending on the actors involved, their position in the arena, the analyst can describe multiple arena configurations (Sahay et al. 2009). This suggests that there are many different ways to understand and act upon the broad marketplace for IT, depending on which point of view the analyst takes.

5. Addressing Multiple Historical Time Frames

A corollary of our insistence upon the need to examine sociotechnical change at multiple levels of generality, in terms of addressing immediate contexts of action and broader contexts, is that we also need to consider sociotechnical processes temporally and address *multiple historical time frames*. This is in terms of both the unfolding of multiple histories and the different historical time frames around which an object, event, or activity may need to be analyzed. Multiple intertwined histories and time frames are intrinsic to our attempts to capture the evolution of a new technology, addressing, for example, both its development and adoption. In this way, we seek to capture the complex sets of developments taking place across a variety of locales, encompassing both the "local" context of immediate action and interaction, and its patterning by a broader context. This broader context is constituted by the aggregate outcomes of previous actions which, in turn, provide a less readily negotiable set of factors that frame and pattern outcomes and which need to be analyzed over longer-term timescales. It is important to pay attention to the multiple dynamics and time frames surrounding innovation. For example, the dynamics of technology development and appropriation may differ. In the case of information and communication technologies (ICTs), where development cycles may have shortened to a year or two, appropriation cycles may be an order of magnitude greater, with new consumer products taking decades to diffuse into widespread use and having greater longevity (Leonardi and Barley 2008; though both time frames are becoming shorter). This longevity in appropriation and replacement cycles is particularly marked in the case of organizational information infrastructures such as ERP.

Particular episodes form part of multiple histories. Thus, the implementation of a technology constitutes a particular moment in the development of that technology within one user organization. It is also one of a number of sites of implementation of a particular supplier offering, contributing through its appropriation and further innovation in use (what Fleck 1988b called "innofusion") to the further elaboration and wider adoption of that artifact. That specific story in turn forms part of the evolution of the class of artifacts with which the supplier offering is associated.

We have coined the concept of "biography" to refer to this history of relationships and sites implicated in the evolution of a specific artifact and a class of artifacts. The latter can, of course, be seen as a part of the wider development of organizational technologies in general. As this discussion suggests, a specific history is nested inside other more long-term generalized sets of relations. In theorizing the multiple tempos that we may need to address in analyzing particular episodes, we find considerable merit in the framework articulated by Hyysalo (2004). He draws on Hutchins' (1995) study of how quartermasters learn naval navigation in a system of distributed action, which portrays the simultaneous unfolding of different histories: "Any moment in human conduct is simultaneously a part of the unfolding of a task, the development of the individual doing it, the development of the work community, and the development of the professional practice" (Hyysalo 2004, p. 12). Hyysalo also introduces us to attempts within activity theory to characterize timescales for analyzing social and technological development. His study of the development of new health-care technology highlights three key timescales in the coupling of design and use:

(i) the prevailing ways of organizing design and use in industrial production; Hyysalo refers here to features of the innovation system liable to be stable over many decades: "pervasive and relatively slow changing ways in which design and use are generally organized in industrialized countries" (Hyysalo 2004, p. 13);

(ii) the coupling of a technological field and a societal practice, which he sees as arrangements that are relatively stable over years and decades, though noting the possibility of changes in practices, in technologies, and in the ways these are coupled together; and

(iii) the development of a particular innovation and the organizations and people connected to it.

We can adapt and expand this schema to our own analytical concerns. Hyysalo's longest timescale, prevailing ways of organizing design and use, would perhaps correspond to the initial in-house development of application software by user organizations, the shift to bespoke supply by third-party suppliers, and finally the recent resort to packaged solutions for organizational technologies.

Our concept of biography would also encompass his other shorter timescales. The coupling of a technological field and societal practice that corresponds

to the biography of a technological field might be how ideas about good industrial practice and the role of technology in achieving develop in tandem. More concretely, this could be how the particular *class of system* is reshaped in line with prescriptions of best practice and broader visions of business improvement (as when for instance there were opportunistic and ephemeral coupling made between ERP and e-business; Pollock and Williams 2009a).

The development of a particular innovation to address the biography of a specific artifact (this could be SAP's R/3 system or Oracle's CRM system) would also be related to the biography of an implemented artifact (e.g., SAP's R/3 systems as it is implemented in a specific user organization).

Choices about the temporal framing of enquiry have important implications for what may be viewed. For example, local studies of immediate settings of action inevitably draw attention to the scope for discretion (user workarounds, appropriation strategies, resistance etc.; cf. Boudreau and Robey 2005) but provide a poor vantage point for exploring longer-term processes of technology-organizational alignment (for example around common business process templates within enterprise systems; cf. Benders et al. 2006). The latter may need to be captured by other modes of research (for example, large-scale surveys or longitudinal studies). Rather than invoke one modality of research, we seek to retain awareness of the multiple historical registers that surround a particular phenomena (Pollock and Williams 2009a). The research design choices we make regarding which time frames and historical registers are to be centrally addressed also parallel our choices regarding the adoption of a local or more global gaze. Although the arena concept provides tools for looking at social space, the temporal distribution also needs attention.

We are proposing a *relational* approach that brings to the foreground certain features for detailed analysis—but within a broader historical register that also records other levels of generality and tempi. Our work seeks to find ways of probing and addressing these other levels/tempi through the adoption of a complex methodology (see below). We contrast this, inevitably messy, endeavor to other dominant social scientific research approaches that recognize only a single register for analysis (whether of immediate action or of broader structuring). We see this failing, for example, in the earlier structuralist explanations (Orlikowski 1992, DeSanctis and Poole 1994) that overlooked more micro aspects, and also in the "atomistic individualism"—a term that characterizes much recent work from a constructivist background that only recognizes immediate contexts of action. We contend that this failing yields a reductionist account of complex social processes. However, rather than propose a particular level of analysis, we emphasize the benefits of *multilevel* analyses, which may have different depths and centers of focus depending on the issue under analysis. The particular scope and framing of analysis selected depends upon the matters under examination. For us, the matter of research design and epistemology should be driven by a critical reflection about which (spatial/temporal) slices of complex sociotechnical fabric are brought into the center of our analytic gaze by particular modes of research viewpoints and concerns.

6. Future Research Directions

Adequate study of the IT artifact remains one of the central challenges facing information systems researchers (Orlikowski and Iacono 2001). The generic enterprise solution is no exception; its study presents scholars with particular difficulties (Light and Sawyer 2007). Integrated IT applications are extremely complex sociotechnical assemblages encompassing a huge variety of elements that are shaped over space and time (Koch 2007, Light and Sawyer 2007). However, scholars have arguably produced rather partial accounts (in both senses of the word partial) that address only a small fragment of the complex and interconnected relationships that constitute real-world phenomena, by means of studies that remain framed around and restricted to selective arrays of actors and settings, time frames, and issues. This is because particular (sub)disciplines and schools of social scientific analysis will often be associated with characteristic temporal and spatial framings of a phenomenon—motivated by the things each seeks to explain and its view of the aetiology of phenomena. To the extent that these framings focus primarily or exclusively on particular moments and settings, they can skew the conduct of research and its findings. We are not alone in noting the narrowness of currently prevalent viewpoints (Crowston and Myers 2004, Nandhakumar et al., 2005, Lyytinen et al., 2009), and there is a growing awareness of the need for new modes of study. How then are we to research these large-scale software packages, where there are complex arrays of relationships, both localized and aggregate, that unfold over different timescales?

This paper has attempted to articulate some new directions for studying packaged enterprise solutions (Table 1 points to some of the differences between single site implementation studies and the biographies approach outlined here). We have suggested that scholars should broaden the sites and timescales they might potentially investigate. Whereas many have unreflexively adopted customary research designs and framings from their discipline or analytical position that traditionally view technologies from

Table 1 Differences Between Single Site Implementation Studies and Biographical Studies

	Single site implementation study	Biographical study
Time	(i) Tend toward a single temporal frame (often immediate action that may inadvertently emphasize the victory of "local" over "global") (ii) Comprised of relatively short-term (often ethnographic) studies. These may fail to capture the longer-term consequences of systems on adopting organizations (iii) Ethnographers tend to "leave to soon." This is problematic because enterprise adoption cycles are typically longer than most social science research projects	(i) Attempt to build multiple time frames of analysis (ii) Studies not only of immediate action but also over the extended development and adoption cycle (longitudinal studies) (iii) Attempting novel forms of study: "comparative" studies of different systems/projects at different moments in the development/adoption cycle; "foreshortened" multisite studies (Marcus 1995)
Space	(i) Often employ a single spatial register that focuses predominately on the adopter site (ii) Focus on the single organization (or actor networks) that can miss important couplings between technology vendors and users	(i) Seeking to study multiple locales. Design, implementation, and use need to be studied together. (ii) Focus on array of overlapping arenas (so as to capture linkages and interactions between different sites and players). Suggests a particular focus on organizational interstices and intermediaries)
Actors	(i) Studies focus on relatively limited number of players (little attention give to those outside the adopter organization) (ii) During single site implementation studies the immediate actors are already in the frame but extra-organizational actors/relationships tend to get overlooked (iii) ANT does allow for shifts in focus/locus by "following the actor" but this may not give adequate guidance as to which actors to follow and how far	(i) Use theoretical and empirical understandings to map the diverse arrays of local and broader actors and interactions between them depending on goals of analysis (ii) Shifts in focus/locus through "following the technology through space and time" encompassing actors and interactions in both immediate settings and broader contexts
Technological field	(i) Single site ethnographies (or actor centred studies) background historical and institutional factors (ii) Emphasis on local contingencies tends to produce "unique" findings	(i) Foregrounds intermediaries and experts constituting market for enterprise solutions (note the emergence of actors who police the field) (ii) Seeking to study the social fabric of the technological field and how this changes over time (iii) Attempting a more systematic study with the possibility of generalization

particular spaces and particular times, for example, foregrounding actors and factors directly implicated in the immediate circumstances of implementation, we argue the need to follow technologies through space and time. That is, to trace the long-term development of packaged systems both *prior to* and *after* their organizational implementation (Kallinikos 2004b, Koch 2005, 2007). However, the important point we wish to reinforce here is that it is not simply the evolution of the system that is to be studied but also the wide range of actors and factors attached to and surrounding the technology. This is because these too are evolving. The various arenas that constitute enterprise solutions (the development arenas, implementation arenas, interorganizational arenas of user firms, and networks of external experts, and so on) are all developing and changing together—and it is only really a multisite, multitime perspective that is able to capture this (Orlikowski and Barley 2001, Crowston and Myers 2004).

Packaged enterprise solutions develop and evolve within an extended sociotechnical space and are influenced by specific and more generalized sets of social relations at a number of different levels. The design, implementation, and use of these systems are mediated by a variety of different experts and intermediaries. Thus an analysis of the shaping of the enterprise system, even at the level of the single software lifecycle, needs to address the broader web of relations that constitute the wider context. These comments apply also to the historical framing and timescales of our research. The implementation of a packaged solution constitutes a moment in the history of that system at one particular organization. It is also one of a number of sites of implementation of a particular supplier offering, contributing through its innofusion and appropriation to the further elaboration and wider adoption of that specific artifact. That specific story in turn forms part of the evolution of the class of artifacts with which the supplier offering is associated. The latter can, at a more general level, be seen as a phase in the development of technological fields and organizational technologies more generally.

We are suggesting a different kind of study. It is one structured around the choice of more adequate methodologies and research designs that are capable of dealing with the complex phenomena under hand. These relate to the sheer scale and the multiple actors and factors involved in the development and evolution of enterprise systems. However, although we do hope to capture the full range of actors and factors involved in the biography of a technology,

research, and explanation does need to make boundaries and distinctions. This is for practical reasons as well as reasons of theoretical elegance. Some simplification is needed to produce manageable generalization. Extending the scope of empirical enquiry simultaneously to an ever-increasing number of sites becomes potentially unmanageable. If we are seeking to produce integrative accounts that pay attention to multiple levels and time frames of influence, we need tools to guide a selective, multilevel focus. We have thus drawn on the embryonic biography of artefacts approach, which provides some of the analytical cues as to how we might study these technologies (Pollock and Williams 2009a, Hyysalo 2010). It highlights the important settings for investigation, encompassing immediate sites of interaction as well as the broader context, helping us to achieve an effective research design.

Among other things, it suggests that capturing the dynamics surrounding these systems will require scholars to be "strategic," perhaps more than they have been to date, in the design of research. Marcus (1995) described the method of "strategically situated ethnography" to capture those phenomena that overflowed the single site and argued the need for scholars to make explicit choices about both the places they study as well as the scope of their research. Importantly, on the one hand, these choices will be based on provisional theoretical and empirical understandings of the settings in which new technologies are being shaped and the issues under examination will also of course be influenced by opportunism and pragmatic exigencies. The former might include theoretically informed decisions about which sites and nexuses might be interesting and in need of further study. We do not go into the analysis like newborn children, somehow innocent of theory and able to derive the world from naturalistic observation (as ANT seems to claim). On the other hand, those of us who acknowledge the value of social science research are not forced to see the world through narrow theoretical blinkers. We can hold some prior knowledge as a provisional account of the world we are investigating (a knowledge base that is certainly incomplete and that may prove inappropriate to the matter under examination). This, however, is just the starting point for empirical exploration, to test and refine the analytical schema in relation to particular empirical settings, selected and approached according to our theoretical understandings and analytic concerns.

Moreover, we are not advocating one level of study or single temporal period. Rather, the research design will necessarily depend upon the phenomenon being investigated and the goals of the study. Pragmatically it will be necessary to "foreground" some elements for detailed examination and "background" others. No single methodology will guarantee correct research design. Instead, we emphasize the need to develop complex methodologies and argue for their adequacy in addressing the problem at hand (Robey 1996). To fully understand large-scale packaged software may require not one but a variety of studies. We should be able to *zoom in* and *out* between levels—what elsewhere we have described as a *variable research geometry* (Pollock and Williams 2009a). To do this, multiple methods may be required knitting together different kinds of evidence—including historical studies, ethnographic research, qualitative studies of local, and broader development and perhaps, at times, the use of larger-scale research instruments and quantitative data (Mingers 2001). These differing kinds of evidence have differing strengths and contributions to mapping the dimensions of an issue. Local qualitative research may provide better tools for drawing out intricacies and particularities of social process and is particularly pertinent to exploratory research opening up new understandings of a novel and emerging phenomena. Larger-scale research provides a more effective base for addressing regularities and trends as well as for testing hypothesis and models and confirming findings from exploratory qualitative studies (MacKenzie 1988).

The multiplicity of sites of enquiry improves the span of research (with a manageable loss of intensity of study at the single sites), increasing the number and range of locales sampled. By combining results from different modes of study (interaction-focused, longitudinal, and broader-scale studies), scholars are able to benefit from the respective strengths (and compensate for potential weaknesses and biases) of these different modes of enquiry. In particular, it offers the basis for the kind of rich and detailed account that may be required for an integrated and effective understanding of complex and intricate phenomena such as the emergence and evolution of complex artifacts and technological fields like enterprise systems. Our concept of biography seeks to characterize these multilocal spaces and multiple time frames within a broader understanding of the evolution of technical fields. We can, for example, track the evolution and shaping of packaged software (following Hyysalo 2004) at three levels:

(i) *Following the biography of an implemented artifact.* The starting point for our focus on biographies was the observation that workplace technologies were often condensations of existing work practices, coupled with a view of achievable change geared toward current conceptions of best practice (Brady et al. 1992, Pollock and Cornford 2004). In other words, information systems were not extrinsic developments coming from outside the industry but at least in part were intrinsic developments. This was obviously true

in relation to the earliest phases of process innovation that arose within the "user organization," for example, in the earliest stages of the application of computing, in which computer systems were built by organizational members (von Hippel 1994). However, it continued even after a specialist supply side had emerged, which continued to be linked to the user, inter alia through the implementation process. Today, as in the recent past, the implemented artifact continues to be an important source for the shaping of packaged software. The implementation of a particular innovation might be addressed through microlevel studies of particular work groups, or perhaps more effectively through studies of particular "implementation arenas" (Fleck 1988b), these hybrid spaces linking together players directly involved in a particular implementation. Such a study might include foregrounded players like managers and different functional divisions of the adopter organization, as well as the technology vendor(s) and the various third-party consultants and experts typically involved. Also present could be a number of background players, such as industry analysts, policy makers and perhaps competing suppliers, some of whom may have been initially foregrounded but, as the selection progresses, become backgrounded. We see as exemplary in this respect Clausen and Koch's (1999) exploration of the social fabric that shaped the evolution of ERP in the 1990s comprising what they described as the "company social constitution" of the adopting organizations, with their own internal dynamics and history, and various "segments" of IT with stable linkages between suppliers and customers. They suggested that knowledge flows within different segments were shaping the evolution of ERP. This included implementation experiences, and the new demands and visions circulated between suppliers and their customers. Crucially, they argued that different segments, and the different procurement strategies and associated forms of supplier-user coupling, offer different opportunities for local influence over the design of the ERP system.

(ii) *Following the biography of a vendor software system.* Connected to these implementations would be the biography of a particular vendor innovation. This might be addressed through microlevel study such as following a particular short-term episode in a design lab. One approach in doing this might be to look for technology controversies that emerge, to find sites where competing options are being contested and where choices and their implications become highlighted (an established technique in our home discipline of science and technology studies). Studies might explore the implications of previous design choices for new organizational users. In this latter respect, there are various interfaces between suppliers and users that constitute key nexuses in which competing requirements are presented and worked out (the "user group" is exemplary in this respect). Effective explanation of this kind of biography might also call for meso-level study, addressing in addition the broader arena encompassing a vendor and its user relations. By this, we mean the interlocking array of actors that could be traced around a particular vendor, its customer relations and competitors and, perhaps, further considering how, in the background, technological fields are being reconstituted in different ways. These issues become particularly foregrounded at particular moments in the biography of a system. One of these is when the system *moves* from one organization, industrial sector, or country to another. Thus the application and use of a software package for the first time in a new kind of setting, constitutes a particularly contested moment in the life of this technology, where there will be questions and concerns about its imputed "generic" applicability. There are a number of studies that have touched on these concerns. Johannessen and Ellingsen (2009), for instance, noted the different challenges in the supply of health information systems that were designed initially for one setting but then transferred to other contexts and subsequently to a larger market. The generification strategies adopted by the supplier in their study bear striking resemblances to the generification strategies articulated over time by ERP suppliers. Studies by Wagner and Newell (2004) have looked at similar issues in the transfer of ERP to universities.

(iii) *Following the biography of the technological field.* In studying this kind of biography a broader macrolevel focus might address the multiple arrays of arenas around particular innovation/artifact biographies constituting a particular field of technological practice, along with players operating primarily at this interorganizational level (industry analysts, policy makers, etc.). We find an interesting pattern of linkages between classes of technology, their nomenclature and managerial prescriptions of best practice, and broader visions of business improvement. We can observe stable linkages, for example, between ERP and the idea of process improvement. We can also find instances in which looser, more opportunistic and ephemeral couplings are made between, say, ERP and e-business (Pollock and Williams 2009a). Studying this kind of biography might also involve a more meso-level study that addressed how various actors attempt to constitute the wider understanding of a type of technology. Key in this latter study would be various kinds of *boundary work* (Gieryn 1999) that police and may at times shift understandings of technological fields. For instance, in the historical emergence of ERP we find striking changes in its

constitution, which started off through discussions by production managers about optimising the production scheduling that underpinned MRP systems and later became focused upon integrated (MRP II, ERP) software solutions that could improve organizational performance through information sharing and better business processes (Pollock and Williams 2009a). More recently, the emphasis of current ERP system development efforts has shifted from integration of activities within the organization toward rationalizing the interface between the organization and its customers. This is evidenced, for instance, by many ERP suppliers now including CRM systems within their offerings, which were, until a couple of years ago, previously unrelated types of systems. Moreover, these latter developments suggest that a further central moment in the biography of a technological field is when previously separate classes of systems *collide* or *converge*. Research here might foreground those players with the influence to recast a boundary in particular ways. This is sometimes the work of powerful vendors but increasingly it is groups like industry analysts that have the ability to *name* (and in some cases *rename*) classes of technology (Gartner's efforts are legend in this respect). This kind of study would sensitize us to the importance of the various intermediaries that link technology supply and use, spanning locales and levels. It also raises the issues of what is at stake in changes in nomenclature/boundaries. It would be fair to say that there have been rather few studies conducted at this level.

Our biographies approach is not without limitations. Bringing different sites or times into the same frame of analysis is not easy. Combining studies of immediate action with longitudinal forms of research presents particular challenges. Although undertaking contemporary study of the initial stages of technology development or of implementation is doable in the context of the typical duration of social science investigations or Ph.D. studies of a year or two, a contemporary study of the complete cycle of technology development, implementation, and use is more problematic. However, the fact that there are trade-offs between breadth and depth of study does not necessarily mean researchers should opt for one or the other mode of analysis. We see this as part of the more strategic approach to the research advocated above, focusing attention on the trade-offs that therefore need to "be managed." To overcome the constraint of the long timescales of the software package lifecycle, for instance, researchers might knit together a selected array of contemporary studies within a comparative frame of a number of selected locales. Czarniawska (2004, p. 786), for instance, has argued in a parallel discussion of these issues within the field of organization studies, that one solution to this problem is "…not to prolong the fieldwork but to study the same object in different places at the same time." In our own work, we undertook a slightly different strategy studying two different artifacts at different stages in their life cycle; we compared an emerging packaged software product at one particular vendor with a more mature product from another supplier (Pollock et al. 2007). We also examined user-group meetings of *different* vendors, which allowed us access to the different character of linkages between technology supplier and user in relation to the different phases and locales in the biography of particular artifacts.

Added to this, research might be conceived of in more "programmatic" terms where shorter-term studies, conducted as part of a number of projects, are put together in a strategic manner, that begin to create the biography of the particular technology under study. Not all pieces of research need be done by the same fieldworker. Some have gone as far to suggest that studying today's complex information systems is increasingly a "team task" and not something to be tackled through single study (Burawoy et al. 2000, Crowston and Myers 2004, Koch 2007). Whatever kind of study one conducts, there will be "choices" that must be taken—most obviously between "breadth" and "depth": in terms of the intensity and diversity of sites of analysis researchers need to be aware of the trade-offs and be more explicit about their decisions. It may, of course, be that they choose to conduct a fine-grained study because they hope to capture the nuances of particular phenomena. Alternatively, field-workers may seek to carry out only an implementation study because they have found gaining access to settings like vendors to be difficult. In both cases however, there is no reason why one should not attempt what Marcus (1995, p. 110) has described as the "foreshortened multisite project." That is, even though the other spaces and time frames are not directly observed, the field-worker actively makes the choice to attempt to understand something about the wider context in which the local implementation is embedded. This might include tracing out the linkages to the array of arenas and histories that surround and influence a technology rollout—a form of study that does not appear difficult to do as most modern day IT projects are so interconnected with multiple settings and time frames that it seems that, as Strannegård and Friberg (2001) point out, all the local elements and actors are "already elsewhere" (Czarniawska 2004).

Conclusions

The time has come to move beyond the single site implementation study. We join in with the call by Howcroft et al. (2004) suggesting the need for new

modes of research. This will not be an easy task and will require that scholars give greater attention to issues of methodology and analytical framework. Current approaches have tended to provide rather weak templates for understanding the full complexities surrounding packaged information systems. We are not *against* these types of studies or the insights they bring, far from it, but note how by themselves they run the risk of generating reduced forms of investigation. Rather than propose a particular level of focus, therefore, we emphasize the benefits of multilevel studies, which may have different depths and centers of analysis depending on the issue under scrutiny. The particular scope and framing of analysis selected depends upon the matters under examination. For us the matter of research design and epistemology should be driven by a critical reflection about which (spatial/temporal) slices of complex sociotechnical fabric are brought into the center of the scholars' gaze by particular modes of research and from what viewpoints. A more diverse evidence base—in terms of locales of study and modes of analysis—arguably also provides the basis for more robust explanation. It may be that a multiplicity of theories and methods are pertinent in doing this (Robey 1996).

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References

Akera, A. 2001. Voluntarism and the fruits of collaboration: The IBM user group, Share. *Tech. Culture* **42**(4) 710–736.

Al-Mashari, M. 2003. Enterprise resource planning (ERP) systems: A research agenda. *Indust. Management Data Systems* **102**(3) 165–170.

Beekhuyzen, J., L. von Hellens. 2006. An actor-network theory perspective of online banking in Australia. *AMCIS Proc.*, Paper 374. http://aisel.aisnet.org/amcis2006/374.

Benders, J., R. Batenburg, H. van der Blonk. 2006. Sticking to standards: Technical and other isomorphic pressures in deploying ERP-systems. *Inform. Management* **43**(2) 194–203.

Berchet, C., G. Habchi. 2005. The implementation and deployment of an ERP system: An industrial case study. *Comput. Indust.* **56**(6) 588–605.

Bond, B., Y. Genovese, D. Miklovic, B. Zrimsek, N. Rayner. 2000. ERP is dead—Long live ERP II. *Gartner Group Research Note* (October 4). RAS Services, Stamford, CT.

Boudreau, M., D. Robey. 2005. Enacting integrated information technology: A human agency perspective. *Organ. Sci.* **16**(1) 3–18.

Brady, T., M. Tierney, R. Williams. 1992. The commodification of industry-application software. *Indust. Corporate Change* **1**(3) 489–514.

Bruni, A. 2005. Shadowing software and clinical records: On the ethnography of non-humans and heterogeneous contexts. *Organization* **12**(3) 357–378.

Burawoy, M., J. Blum, S. George, Z. Gille, T. Gowan, L. Haney, M. Klawiter, S. Lopez, S. O'Riain, M. Thayer. 2000. *Global Ethnography: Forces, Connections, and Imaginations in a Postmodern World*. University of California Press, Berkeley, CA.

Callon, M. 1986. The sociology of an actor network: The case of the electric vehicle. M. Callon, J. Law, A. Rip, eds. *Mapping the Dynamics of Science and Technology*. Macmillan, London, 19–34.

Callon, M., B. Latour. 1981. Unscrewing the big Leviathan: How actors macrostructure reality and how sociologists help them to do so. K. D. Knorr-Cetina, A. V. Cicourel, eds. *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*. Routledge and Kegan Paul, Boston, 103–131.

Callon, M., J. Law. 1982. On interests and their transformation: Enrolment and counter-enrolment. *Soc. Stud. Sci.* **12**(4) 615–625.

Ciborra, C. U. 1999. A theory of information systems based on improvisation. W. Currie, B. Galliers, eds. *Rethinking Management Information Systems: An Interdisciplinary Perspective.* Oxford University Press, Oxford, UK, 136–155.

Ciborra, C. U., O. Hanseth. 1998. From tool to Gestell: Agendas for managing the information infrastructure. *Inform. Tech. People* **11**(4) 305–327.

Ciborra, C., K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Vespo, J. Ljungberg, E. Monteiro, K. Simon, eds. 2000. *From Control to Drift: The Dynamics of Corporate Information Infrastructures*. Oxford University Press, Oxford, UK.

Clausen, C., C. Koch. 1999. The role of spaces and occasions in the transformation of information technologies: Lessons from the social shaping of IT systems for manufacturing in a Danish context. *Tech. Anal. Strat. Man.* **11**(3) 463–482.

Cornford, J., N. Pollock. 2003. *Putting the University Online: Information, Technology and Organisational Change*. Open University Press, Milton Keynes.

Crowston, K., M. Myers. 2004. Information technology and the transformation of industries: Three research perspectives. *J. Strategic Inform. Systems* **13**(1) 5–28.

Czarniawska, B. 2004. On time, space and action nets. *Organization* **11**(6) 773–791.

DeSanctis, G., M. Poole. 1994. Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organ. Sci.* **5**(2) 121–147.

Elbanna, A. 2006. The validity of the improvisation argument in the implementation of rigid technology: The case of ERP systems. *J. Inform. Tech.* **21**(3) 165–175.

ERP Research Group. 2006. ERP systems and related issues bibliography: 600 articles (updated 5 May 2006; accessed 15 May 2007). Victoria University Australia, Available online: http://www.business.vu.edu.au/sap/Research.html#ERP_Systems_and_Related_Issues_Bibliogr.

Esteves, J., J. Pastor. 2001. Enterprise resource planning systems research: An annotated bibliography. *Comm. AIS* **7**(8) 1–52.

Finkelstein, A., G. Spanoudakis, M. Ryan. 1996. Software package requirements and procurement. *Proc. 8th Internat. Workshop Software Specification Design*, IEEE Computer Society Press, Schloss Velen, Germany, 141–146.

Fleck, J. 1988a. The development of information integration: Beyond CIM? Edinburgh PICT Working Paper 9, Research Centre for Social Sciences, Edinburgh University, Edinburgh, UK.

Fleck, J. 1988b. Innofusion or diffusation?: The nature of technological development in robotics. Edinburgh PICT Working Paper No. 4, Research Centre for Social Sciences, University of Edinburgh, Edinburgh, UK.

Fleck, J. 1993. Configurations: Crystallizing contingency. *Human. Factors Manufacturing* **3**(1) 15–36.

Fleck, J., J. Webster, R. Williams. 1990. The dynamics of IT implementation: A reassessment of paradigms and trajectories of development. *Futures* **22**(6) 618–640.

Gieryn, T. 1999. *Cultural Boundaries of Science: Credibility on the Line*. University of Chicago Press, Chicago.

Grabot, B., V. Botta-Genoulaz. 2005. Editorial: Special issue on enterprise resource planning (ERP) systems. *Comput. Indust.* **56**(6) 507–509.

Hanseth, O., K. Braa. 2000. Technology as traitor: Emergent SAP infrastructure in a global organization. R. Hirschheim, M. Newman, and J. I. DeGross, eds. *Proc. Nineteenth Internat. Conf. Inform. System*, Atlanta. ICIS, 188–196 .

Hislop, D. 2002. The client role in consultancy relations during the appropriation of technological innovations. *Res. Policy* **31**(5) 657–671.

Ho, X., M. Tan. 2004. Leveraging methodological pluralism in interpretive IS research: The example of ERP as a complex phenomenon. L. T. Saarinen, T. Klein, eds. *Proc. Twelfth Euro. Conf. Inform. Systems*, Turku School of Economics and Business Administration, Turku, Finland.

Howcroft, D., S. Newell, E. Wagner. 2004. Editorial: Understanding the contextual influences on enterprise system design, implementation, use and evaluation. *J. Strategic Inform. Systems* **13**(2) 271–277.

Hutchins, E. 1995. *Cognition in the Wild*. MIT Press, Cambridge, MA.

Hyysalo, S. 2004. Uses of innovation: Wristcare in the practices of engineers and elderly academic dissertation. Academic Dissertation, Department of Education, University of Helsinki, Finland.

Hyysalo, S. 2010. *Health Technology Development and Use: From Practice-Bound Imagination to Evolving Impacts*. Routledge, London.

Johannessen, L., G. Ellingsen. 2009. Integration and generification: Agile software development in the health-care market. *Comput. Supported Cooperative Work* **18**(5–6) 607–634.

Jones, M. 2000. The moving finger: The use of social theory in WG 8.2 conference papers, 1975–1999. R. Baskerville, J. Stage, J. DeGross, eds. *Organizational and Social Perspectives on Information Technology*. Kluwer Academic Publishers, Boston, 15–32.

Jørgensen, U., O. Sørensen. 1999. Arenas of development: A space populated by actor worlds, artifacts, and surprises. *Tech. Anal. Strategic Management* **11**(3) 409–429.

Judd, M. 2006. Open and flexible. *Internat. Audit. Bus. Risk* **June** 34–38.

Kallinikos, J. 2004a. Farewell to constructivism: Technology and context-embedded action. C. Avgerou, C. Ciborra, F. Land, eds. *The Social Study of Information and Communication Technology: Innovation, Actors, and Contexts*. Oxford University Press, Oxford, UK, 141–161.

Kallinikos, J. 2004b. Deconstructing information packages: Organizational and behavioural implications of ERP systems. *Inform. Tech. People* **17**(1) 8–30.

Kaniadakis, A. 2006. The Agora of techno-organisational change. Unpublished Ph.D. thesis, Research Centre for Social Sciences, University of Edinburgh, UK.

Keil, M., E. Carmel. 1995. Customer-developer links in software development. *Comm. ACM* **38**(5) 33–44.

Knorr-Cetina, K. D. 1981. Introduction: The micro-sociological challenge of macro-sociology: Toward a reconstruction of social theory and methodology. K. D. Knorr-Cetina, A. V. Cicourel, eds. *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*. Routledge and Kegan Paul, Boston, 1–47.

Knorr-Cetina, K. D., U. Bruegger. 2002. Global microstructures: The virtual societies of financial markets. *Amer. J. Soc.* **107**(4) 905–950.

Koch, C. 2003. ERP-software packages: Between mass production communities and intraorganisational political processes. D. Preece, J. Laurila, eds. *Technological Change and Organizational Action* Routledge, London, 56–76.

Koch, C. 2005. Users? What users? Shaping global corporations and generic users with ERP. Yngve Sundblad, Åke Waldins, eds. *Proc. Workshop User-Driven IT Design Quality Assurance*, Royal Institute of Technology, Stockholm, 43–53.

Koch, C. 2007. ERP—A moving target. *Internat. J. Bus. Inform. Systems* **2**(4) 426–443.

Kopytoff, I. 1988. The cultural biography of things: Commoditization as a process. A. Appaduraied, ed. *The Social Life of Things: Commodities in a Cultural Perspective.* Cambridge University Press, Cambridge, UK, 64–91.

Latour, B. 1987. *Science in Action, How to Follow Scientists and Engineers Through Society*. Harvard University Press, Cambridge, MA.

Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press, Oxford, UK.

Law, J. 1994. *Organizing Modernity*. Blackwell, Oxford, UK.

Law, J. 2004. *After Method: Mess in Social Science Research*. Routledge, London.

Law, J., V. Singleton. 2005. Object lessons. *Organizations* **12**(3) 331–355.

Leonardi, P. M. 2009. Crossing the implementation line: The mutual constitution of technology and organizing across development and use activities. *Comm. Theory* **19**(3) 277–309.

Leonardi, P. M., S. Barley. 2008. Materiality and change: Challenges to building better theory about technology and organizing. *Inform. Organ.* **18**(3) 159–176.

Lewis, L. K., D. Seibold. 1993. Innovation modification during intraorganizational adoption. *Acad. Management Rev.* **18**(2) 322–354.

Lewis, L. K., D. Seibold. 1998. Reconceptualizing organizational change implementation as a communication problem: A review of literature and research agenda. M. Roloff, ed. *Communication Yearbook*, Vol. 21. Sage, Thousand Oaks, CA, 93–151.

Light, B., S. Sawyer. 2007. Locating packaged software in information systems research. *Euro. J. Inform. Systems* **16**(5) 527–530.

Locke, J., A. Lowe. 2007. A biography: Fabrications in the life of an ERP package. *Organization* **14**(6) 793–814.

Lyytinen, K., M. Newman, A. Al-Muharfi. 2009. Institutionalizing enterprise resource planning in the Saudi steel industry: A punctuated socio-technical analysis. *J. Inform. Tech.* **24**(4) 286–304.

Mabert, V., A. Soni, M. Venkataramanan. 2001. Enterprise resource planning: Common myths versus evolving reality. *Bus. Horizon* **44**(3) 69–76.

MacKenzie, D. 1988. Micro versus macro sociologies of science and technology? Edinburgh PICT Working Paper 2, Research Centre for Social Sciences, University of Edinburgh, Edinburgh, UK.

Magolda, P. 2000. Being at the wrong place, wrong time: Rethinking trust in qualitative inquiry. *Theory Into. Practice* **39**(3) 138–145.

Marcus, G. E. 1995. Ethnography in/of the world system: The emergence of multi-sited ethnography. *Ann. Rev. Anthropology* **24** 95–117.

Mingers, J. 2001 Combing IS research methods: Toward a pluralist methodology. *Inform. Systems Res.* **12**(3) 240–259.

Monteiro, E. 2000. Actor-network theory. C. Ciborra, K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Hespo, J. Ljungberg, E. Monteiro, K. Simon, eds. *From Control to Drift: The Dynamics of Corporate Information Infrastructures*. Oxford University Press, Oxford, UK, 71–86.

Morrison, A. 2002. Researching ICTs in context. InterMedia Report 3/2002, University of Oslo, Oslo.

Nandhakumar, J., M. Rossi, J. Talvinen. 2005. The dynamics of contextual forces of ERP implementation. *J. Strategic Inform. Systems* **14**(2) 221–242.

Orlikowski, W. J. 1992. The duality of technology: Rethinking the concept of technology in organizations. *Org. Sci.* **11**(4) 404–428.

Orlikowski, W. J. 1996. Improvising organisational transformation over time: A situated change perspective. *Inform. Systems Res.* **7**(1) 63–92.

Orlikowski, W. J. 2006. Material knowing: The scaffolding of human knowledgeability. *Euro. J. Inform. Systems* **15**(5) 460–466.

Orlikowski, W. J., S. Barley. 2001. Technology and institutions: What can research on information technology and research on institutions learn from each other? *MIS Quart.* **25**(2) 145–165.

Orlikowski, W. J., C. Iacono. 2001. Research commentary: Desperately seeking the "IT" in IT research—A call to theorizing the IT artifact. *Inform. Systems Res.* **12**(2) 121–134.

Pollock, N. 2005. When is a work-around? Conflict and struggle in computer systems development. *Sci. Tech. Humam Value* **30**(4) 496–514.

Pollock, N., J. Cornford. 2004. ERP Systems and the University as an "Unique" Organization. *Inf. Tech. Peop.* **17**(1) 31–52.

Pollock, N., R. Williams. 2007. Technology choice and its performance: Toward a sociology of software package procurement. *Information Organ.* **17**(2) 131–161.

Pollock, N., R. Williams. 2009a. *Software and Organizations: The Biography of the Enterprise-wide System or How SAP Conquered the World*. Routledge, London.

Pollock, N., R. Williams. 2009b. The sociology of a market analysis tool: How industry analysts sort and organise markets. *Inform. Organ.* **19**(2) 129–151.

Pollock, N., R. Williams. 2010. The business of expectations: How promissory organisations shape technology and innovation. *Soc. Stud. Sci.* **40**(4) 525–548.

Pollock, N., R. Williams, L. D'Adderio. 2007. Global software and its provenance: Generification work in the production of organisational software packages. *Soc. Stud. Sci.* **37**(2) 254–280.

Pollock, N., R. Williams, R. Proctor. 2003. Fitting standard software packages to non-standard organisations: The "biography" of an enterprise-wide system. *Tech. Anal. Strat. Man.* **15**(3) 317–332.

Pozzebon, M., Pinsonneault. 2005. Global–local negotiations for implementing configurable packages: The power of initial organizational decisions. *J. Strat. Inform. Systems* **14**(2) 191–242.

Pozzebon, M., E. van Heck. 2006. Local adaptations of generic application systems: The case of Veiling Holambra in Brazil. *J. Infor. Tech.* **21**(2) 73–85.

Quattrone, P., T. Hopper. 2006. What is IT? SAP, accounting, and visibility in a multinational organization. *Infor. Org.* **16**(3) 212–250.

Regnell, B., M. Höst, J. Natt och Dag, P. Beremark, T. Hjelm. 2001. An industrial case study on distributed prioritisation in market-driven requirements engineering for packaged software. *Req. Eng.* **6**(1) 51–62.

Robey, D. 1996. Diversity in information systems research: Threat, promise and responsibility. *Inform. Systems Res.* **7**(4) 400–408.

Rose, J., M. Jones, D. Truex. 2005. Socio-theoretic accounts of IS: The problem of agency. *Scandinavian J. Inform. Systems* **17**(1) 133–152.

Rowlands, N. 2010. Turning buyers into sellers: The spread and spreading of ERP in American higher education. Presentation, September 2–4, 2010, European Association for the Study of Science and Technology, Trento, Italy.

Sahay, S., E. Monteiro, M. Aanestad. 2009. Configurable politics and asymmetric integration: Health e-infrastructures in India. *J. Assoc. Inform. Systems* **10**(5) 399–414.

Sawyer, S. 2001. A market-based perspective on information systems development. *Comm. ACM* **44**(11) 97–101.

Sawyer, S., R. Southwick. 2002. Temporal issues in information and communication technology-enabled organizational change: Evidence from an enterprise systems implementation. *Inform. Soc.* **18**(4) 263–280.

Scott, S. V., E. Wagner. 2003. Networks, negotiations, and new times: The implementation of enterprise resource planning into an academic administration. *Inform. Organ.* **13**(4) 285–313.

Shoib, G., J. Nandhakumar, M. Jones. 2006. Using social theory in information systems research: A reflexive account, in quality and impact of qualitative research. A. Ruth, ed. *Quality and Impact of Qualitative Research, 3rd Annual Qual. IT Conf.*, Institute for Integrated and Intelligent Systems, Griffith University, Brisbane, Australia, 129–147.

Silverstone, R., E. Hirsch, D. Morley. 1992. Information and communication technologies and the moral economy of the household. R. Silverstone, E. Hirsch, eds. *Consuming Technologies: Media and Information in Domestic Spaces*. Routledge, London, 115–131.

Smith, W. 2009. Theatre of use: A frame analysis of information technology demonstrations. *Soc. Stud. Sci.* **39**(3) 449–480.

Sørensen, K. H. 1996. Learning technology, constructing culture: Socio-technical change as social learning'. STS Working Paper No. 18/96, Centre for Technology and Society, Norwegian University of Science and Technology, Trondheim, Norway.

Sørensen, K. H., N. Levold. 1992. Tacit Networks, Heterogeneous Engineers, and Embodied Technology. *Sci. Tech. Human Values* **17**(1) 13–35.

Sørensen, K., R. Williams. 2002. *Shaping Technology, Guiding Policy: Concepts, Spaces and Tools*. Edward Elgar, Cheltenham, UK.

Star, S. L., ed. 1995. *Ecologies of Knowledge*. State University of New York Press, New York.

Star, S. L., K. Ruhleder. 1996. Steps toward an ecology of infrastructure: Design and access for large information spaces. *Inform. Systems Res.* **7**(1) 111–134.

Strannegård, L., M. Friberg. 2001. *Already Elsewhere: Play, Identity and Speed in the Business World*. Raster, Stockholm.

Suchman, L. 1987. Plans and situated actions: The problem of human–machine communication. Cambridge University Press, Cambridge, UK.

Suchman, L. 1994. Working relations of technology'. *Comp. Supp. Coop. Work* **2**(1–2) 21–39.

Suchman, L. 2007. *Human-Machine Reconfigurations: Plans and Situated Actions*. Cambridge University Press, Cambridge, UK.

Swanson, E. B. 2010. Consultancies and capabilities in innovating with IT. *J. Strategic Inform. Systems* **19**(1) 17–27.

Swanson, E. B., N. Ramiller. 1997. The organizing vision in information systems innovation. *Organ. Sci.* **8**(5) 458–474.

Tingling, P., M. Parent. 2002. Mimetic isomorphism and technology evaluation: Does imitation transcend judgement. *J. Assoc. Inform. Systems* **3**(5) 113–143.

Tingling, P., M. Parent. 2004. An exploration of enterprise technology selection and evaluation. *J. Strategic Inform. Systems* **13**(4) 329–354.

Von Hippel, E. 1994. *The Sources of Innovation*. Oxford University Press, UK.

Von Hippel, E. 2005. *Democratizing Innovation*. MIT Press, Cambridge, MA.

Wagner, E., S. Newell. 2004. Best for whom? The tension between "best practice" ERP packages and diverse epistemic cultures in a university context. *J. Strategic Inform. Systems.* **13**(4) 305–328.

Walsham, G. 1997. Actor-network theory and IS research: Current status and future prospects. A. S. Lee, J. Liebenau, J. DeGross, eds. *Information Systems and Qualitative Research*. Chapman & Hall, New York, 469–480.

Walsham, G. 2001. *Making a World of Difference: IT in a Global Context*. Wiley, Chichester, UK.

Wang, P., N. Ramiller. 2004. Community learning in information technology fashion. *ICIS 2004 Proc.*, Paper 4. ICIS, Atlanta. http://aisel.aisnet.org/icis2004/4.

Wang, P., E. Swanson. 2008. Customer relationship management as advertised: Exploiting and sustaining technological momentum. *Inform. Tech. People* **21**(4) 323–349.

Webster, J., R. Williams. 1993. Mismatch and tension: Standard packages and non-standard users. P. Quintas, ed. *Social Dimensions of Systems Engineering*. Ellis Horwood, Hemel Hempstead, UK, 179–196.

Williams, R. 1997. Universal solutions or local contingencies? Tensions and contradictions in the mutual shaping of technology and work organisation'. I. McLoughlin, D. Mason, eds. *Innovation, Organizational Change and Technology*. International Thompson Business Press, London, 170–185.

Wylie, L. 1990. A vision of the next-generation MRP II computer integrated manufacturing. Scenario S-300-339. Gartner Group, Stamford, CT.